DIFFERENTIAL SENSITIVITY TO ETHYLENE OF THE VARIOUS RIPENING PATHWAYS OF ETHYLENE-SUPPRESSED CANTALOUPE MELONS

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1. Introduction

The availability of ethylene-suppressed transgenic melon fruit harboring an ACC oxidase gene in antisense orientation (Ayub et al., 1996) allowed to discriminate between ethylene-dependent and ethylene-independent ripening pathways. It has been observed that pulp coloration, accumulation of sugars, and loss of acidity are ethylene independent processes, whereas rind yellowing, flesh softening, development of the peduncular abscission (Guis et al., 1997), aroma production (Bauchot et al., 1998) and respiratory burst (not published) are ethylene dependent. The present study is aimed at characterizing the sensitivity to ethylene of softening of the flesh and yellowing of the rind by treating ethylene-suppressed melons with ethylene. The kinetics of changes have been followed under various ethylene concentrations and upon transfer to air. This has allowed an estimation of the threshold levels of ethylene required for initiating the processes and the saturating levels for full velocity. The effects of the cessation of the ethylene treatment have also been determined.

2. Materials and methods

The line of melon and culture conditions were as in Ayub et al. (1996) and Guis et al. (1997). Fruits were harvested at 38-40 days after pollination and treated with various concentrations of ethylene. The effects of the cessation of the ethylene treatment were assessed by transferring fruit from 5 ppm ethylene to air. Flesh firmness and color of the rind were measured as described by Guis et al., (1997).

3. Results and discussion

Figure 1A shows that AS fruit untreated or treated with 0.1 and 1.0 ppm ethylene underwent a similar and slow decrease in firmness. At a threshold level of 2.5 ppm, softening was strongly stimulated and proceeded at the same rate in WT fruit and AS fruit treated with 2.5, 5 and 50 ppm. By contrast, the rate of yellowing of the rind was proportional to C₂H₄ concentration (Fig. 1B) between 1 and 5 ppm. It reached a saturation for 5 ppm. The saturating levels of ethylene for both processes were by far lower than the internal ethylene found at the climacteric peak of wild type fruit (over 100 ppm). These results show that the sensitivity to ethylene was not affected by the genetic transformation, similarly to antisense ACC synthase tomatoes (Oeller et al., 1991). In contrast, full sensitivity to ethylene has not been observed in lines of antisense ACC-oxidase tomatoes (Murray et al., 1993). The cessation of ethylene treatment did not result in an arrest of softening that proceeded at a rate similar to untreated AS fruit (Fig. 2A). The presence of an ethylene-independent component in the regulation of softening can be considered as a non-climacteric event. This is in agreement with the observation that some polygalacturonase genes of melon were ethylene-regulated while others were ethylene-independent (Guis et al., 1999). In contrast, transfer to air resulted in a complete arrest of rind degreening, indicating that this process was completely dependent upon
ethylene.

References


Figures

1. Effects of ethylene concentration and treatment duration on flesh firmness (A) and rind color (B) of transgenic melons. (◆) WT + air; (◇) AS + air; (○) AS + 0.1 ppm; (□) AS + 1 ppm; (△) AS + 2.5 ppm; (Δ) AS + 5 ppm; (▲) AS + 50 ppm. Each point represents the average of five independent measurements ± SE.

2. Effects of ethylene treatment (solid line) and transfer to air after 1, 3 and 5 days of treatment (broken line) on flesh firmness (A) and rind color (B) of transgenic melons. (◆) WT + air; (◇) AS + air; (Δ) AS + 5 ppm. Each point represents the average of five independent measurements ± SE.